Application of Network Services to the FAA

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Introduction

The Federal Aviation Administration (FAA) is facing a diverse set of challenges as it attempts to meet the needs of its users in the 21st century. In recent years, the FAA has recognized that collaborative solutions – involving various FAA divisions and stakeholders – are required to solve the systemic problems facing the NAS. It is important to realize that for these teams to be successful, collaboration must not only occur on a personnel level, but the teams must also develop information technology (IT) collaboration so that ideas, tools, and data can flow between the stakeholders. This free flow of data and tools is perhaps one of the biggest challenges to the success of some of these teams.

Only recently have new technologies emerged that could simplify tool and data exchange between different organizations. The new technology concept is called web services and it is a way to package and deploy business logic, data and functions so they can be made available to anyone on the network [1]. This same web services concept has application to the publication and exchange of services within the FAA. The purpose of this paper is to describe the application of network service information exchange technologies to the FAA.

Network Services

Network services is a way to create, publish, and access data and analysis services across the FAA Intranet (see Figure 1). Using network services, any client attached to the FAA Intranet can invoke a remote service using a defined communication protocol. A client can be a web browser or a decision support tool. A service can be a data repository or algorithm that is hosted on a centralized server and accessible via the FAA Intranet.

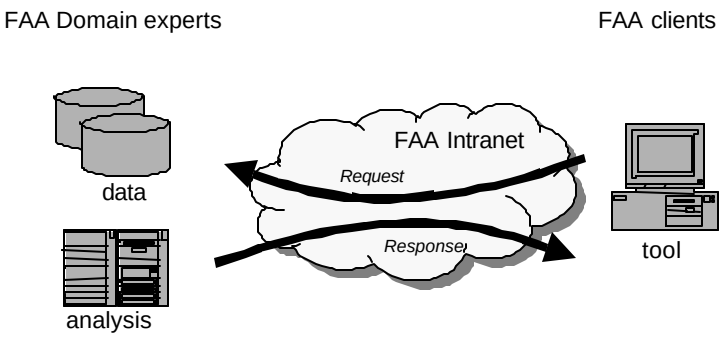

Figure 1: Schematic of the network services concept

Sample services include a traffic data service for obtaining archived traffic data or an analytical service like a noise model calculation that uses input from the client's decision support tool to produce a value-added noise analysis.

The client sends a request for service to the service provider. The service provider processes the request and then sends the results back to the client. The contents of the request and response messages are precisely defined using a service description language. In the proposal that follows, this service description language is defined using XML.

The philosophy of the network services concept is:

- **Availability of the service over a shared communication infrastructure (e.g., FAA Intranet.).** Any FAA client at any FAA facility should have the opportunity to access and use the network service.
- **Support of emerging data exchange standards for the exchange of data and analytical results.** To be efficient, service providers and service users should develop a common interface for accessing a network service. First, the protocol used in the request/response should be standardized so that a client can use the same fundamental interface with different service providers. Next, all parameters used as input and all service outputs need to be unambiguously defined so that the client and service provider have confidence in the results of the service.
- **Management of the services by the domain experts.** The domain expert maintains a single version of the software and does not have to worry about propagating new versions to all groups that are using the data or algorithm. In addition, the domain expert can maintain control of complex analytical routines and/or proprietary data; thus, reducing the potential for compromising proprietary data or algorithms.

The network services architecture has several advantages for the FAA:

- **Maintained by the data/process steward**. The group or entity with the domain experience develops and maintains the data and/or analysis services.
- **Local facilities obtain access to national data sources and analytical tools.** In effect, this pushes more problem identification and analysis capabilities into the field.

- **Fewer errors.** By consolidating the service with the domain expert, the potential for errors in the data and/or algorithms is significantly reduced.
- **Improved security.** Services involving proprietary data can be centralized to prevent the potential release of sensitive information.
- **Cost effective.** Some analytical or data services may require expensive hardware and storage systems: Instead of having to provide an expensive workstation on every desk, network services allows us to deploy cost effective workstations and a single expensive computer to host the service.
- **Accelerates standardization.** Network services requires clients and stewards to develop a common representation for aeronautical data elements.
- **Normalization of results between tools.** Centralizing the services reduces duplication across the FAA and centralization reduces the chance that two FAA divisions will obtain different results for the same analysis.
- **Software availability.** The network services concept is becoming an industry standard for distributed computing in a web-environment. Service providers and service clients have access to a large amount of commercial (and often free) software that can be used to build, maintain, and access network services.

The network services concept is built upon the XML-SOAP web services framework under development at the World Wide Web Consortium (W3C). W3C is an Internet organization whose mission is to develop and promote standards for the web [2]. W3C developed HTML, XML and more recently began working on the Simple Object Access Protocol (SOAP). The working draft of the SOAP specification is taken as the network services standard for the FAA.

SOAP is an open protocol specification for creating a widely distributed computing environment that leverages the Internet infrastructure. The specification includes a minimal protocol for invoking methods on remote services. The SOAP technology uses XML and HTTP protocols for definition and transport, respectively. SOAP provides:

- An encoding technique used to represent calls to remote services
- A standard protocol for using HTTP to transmit XML requests
- Rules for parsing and responding to a remote service request
- Standards for fault detection and reporting
- An equipment-independent protocol for client and server communication.

SOAP uses XML technologies like XML namespaces and XML schemas to build unambiguous messages for exchanging data and results. The latest SOAP implementations use an XML file called a Web Services Description Language (WSDL) file to create a service contract between the client and the server. The WSDL file describes available operations and how the client should request the service and interpret the results.

For more information on the SOAP protocol and XML, the reader is encouraged to visit the W3C web site (www.w3c.org).

The process of identifying and creating a network service can be expressed in five steps:

1. **Identify common needs**. Candidate services are identified based on perceived overlaps in data and analysis needs between tools and/or between FAA divisions.
2. **Identify data and algorithm ownership**. The data and algorithm needs are consolidated under the domain experts.
3. **Build service description (XML).** The service steward needs to work with expected clients to develop the input/output formats that will be used for communication with the service. This includes creating a standard XML schema to represent the relevant data and a SOAP service description language (WSDL) file to represent the request and response messages passed between the service provider and the client.
4. **Deploy as XML-SOAP service.** Using readily available SOAP development toolkits, the service provider needs to implement the service on a web server.
5. **Publish service specifications to governing body.** The final step of the network services process is publishing the service specifications and associated XML schemas to a centralized services repository. Publication ensures that potential clients can easily discover services that they may wish to use.

National Airspace System Resources (NASR) data access service

As a proof of concept demonstration of network services and the XML-SOAP technology, Air Traffic Airspace Management built a prototype NASR airport and runway service. Using this service any FAA client connected to the FAA Intranet can request an extract of NASR data for any airport or runway.

The NASR query service is based upon the SOAP specifications version 1.1 [3]. The service was created using Microsoft's SOAP development toolkit version 2.0 (see http://msdn.microsoft.com/soap/) and Microsoft's Visual Studio 6. Figure 2 shows a schematic of the design and provides information about accessing the NASR query

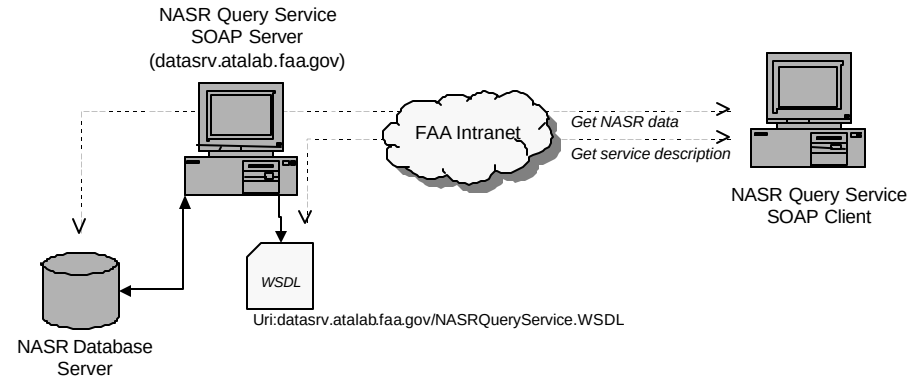

Figure 2: Schematic of the NASR data access service

service. The web services description language (WSDL) file defines two query services: getairportinformation and getrunwayinformation.

Conclusions

Network services is a concept for sharing data and analytical services over a common FAA communications infrastructure. Using open standards technologies, like XML and SOAP, it is possible to build and deploy a data/analysis service over the FAA Intranet quickly. The network services concept has the potential to greatly increase the speed and ease at which data and analysis are shared across FAA divisions. The network services design is based on three premises:

- ?? Common communications infrastructure for transferring data and analytical results
- ?? Local ownership of a data/analysis service with the domain expert
- ?? Use of open standards for describing the service request/response messages

We have implemented data access services that provide selected aeronautical data from the National Airspace System Resources (NASR) database. This service has been published to the FAA Intranet and can be used to request runway and airport information.

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